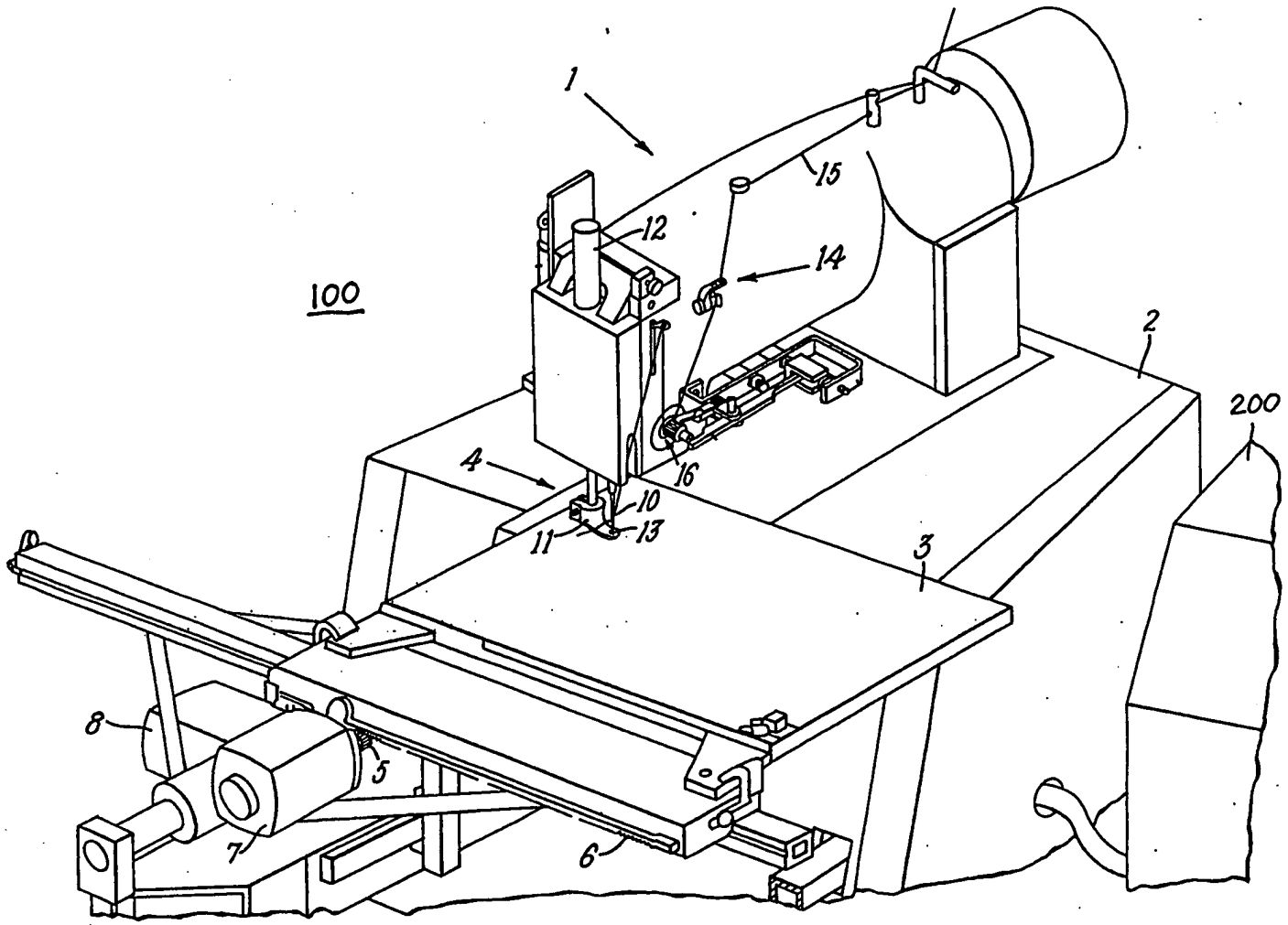


FIG. 1A
PRIOR ART

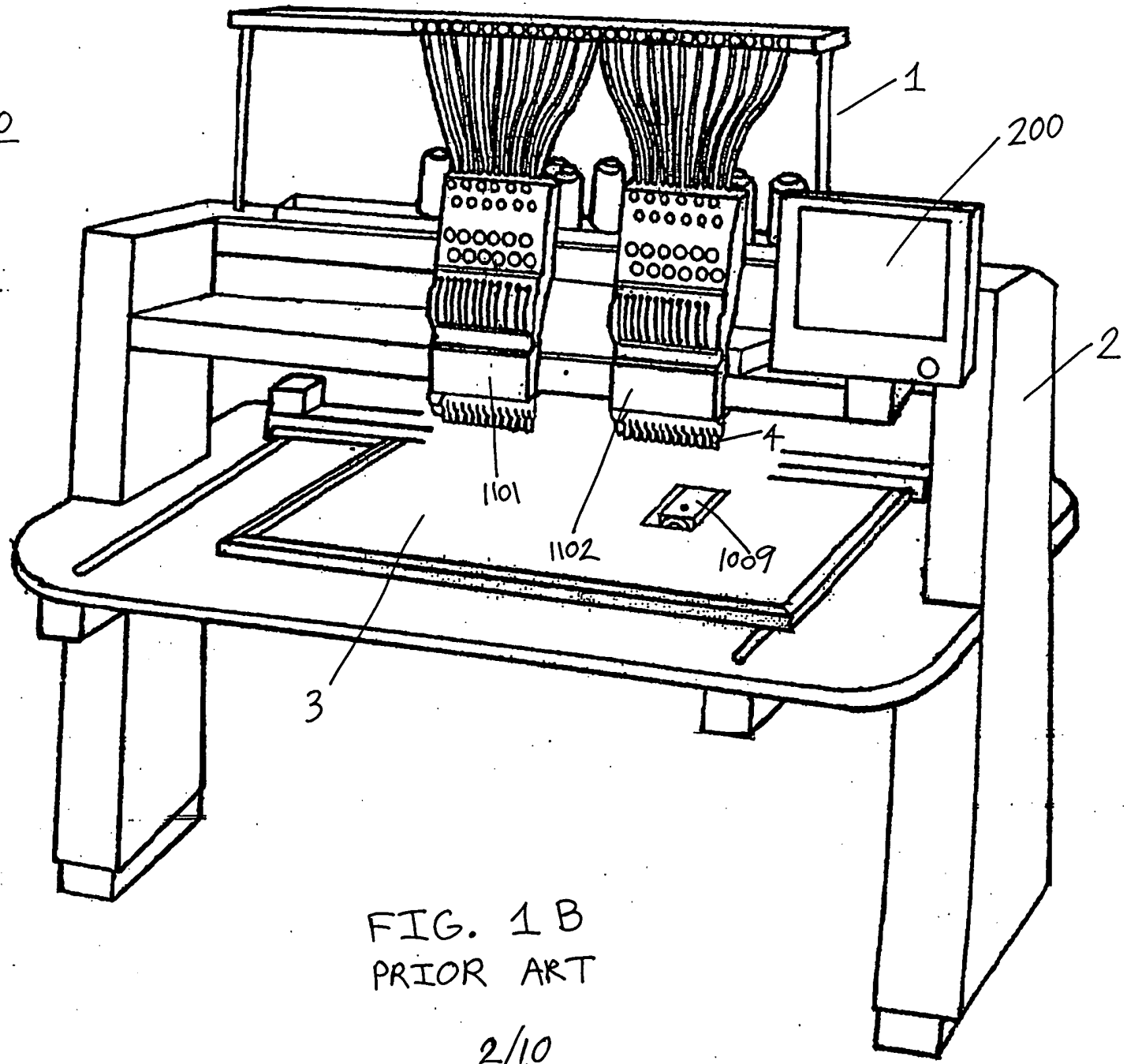
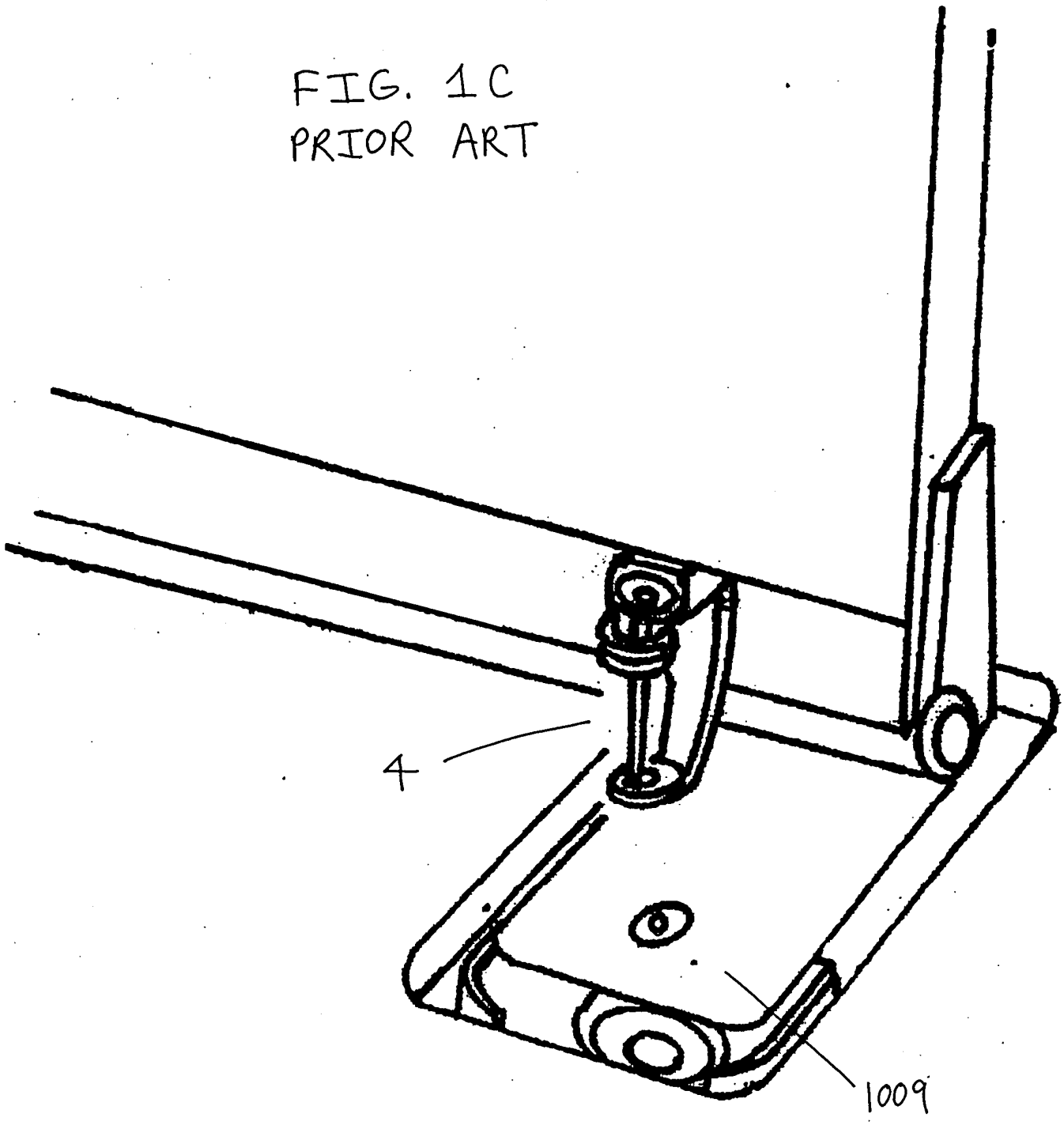


FIG. 1B
PRIOR ART

FIG. 1C
PRIOR ART



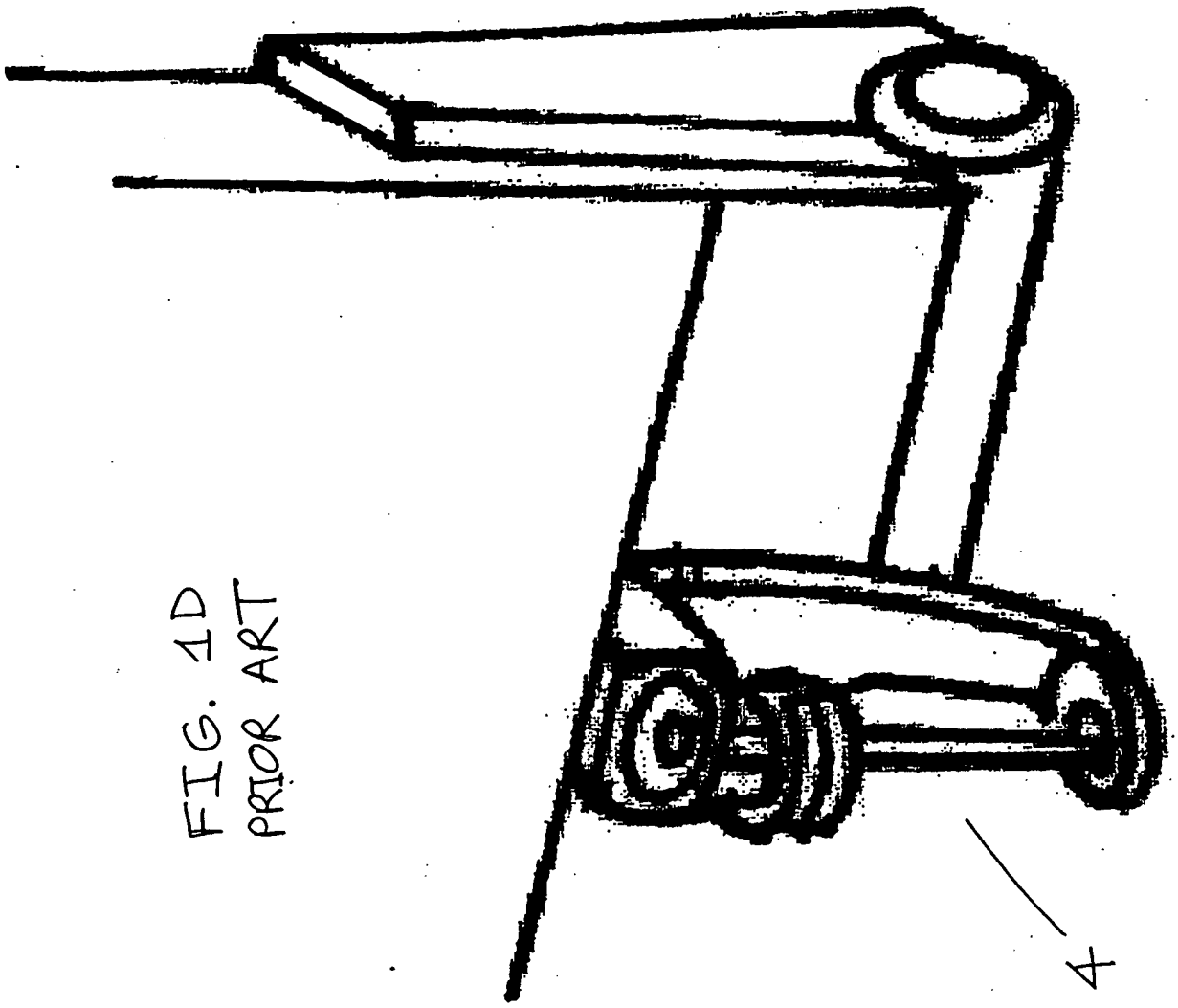


FIG. 1D
PRIOR ART

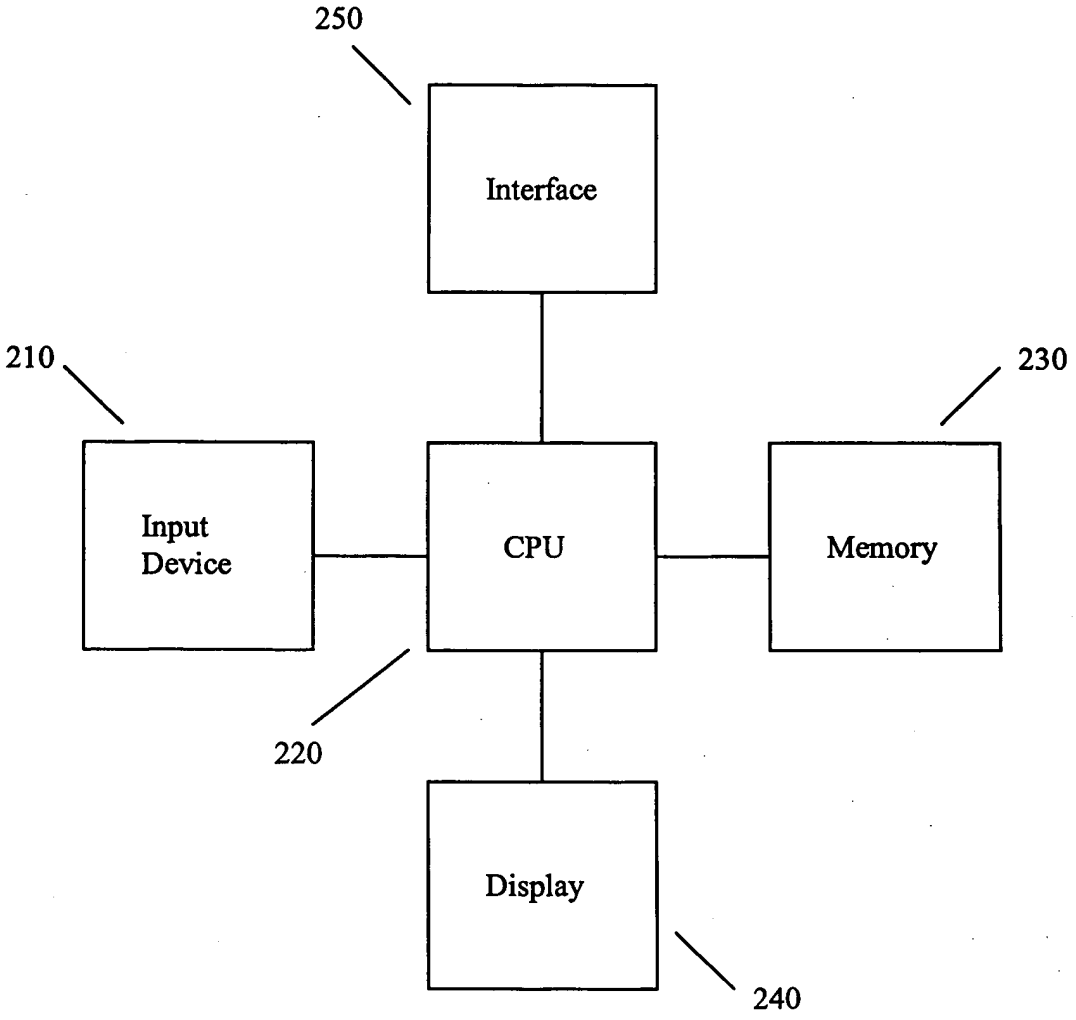
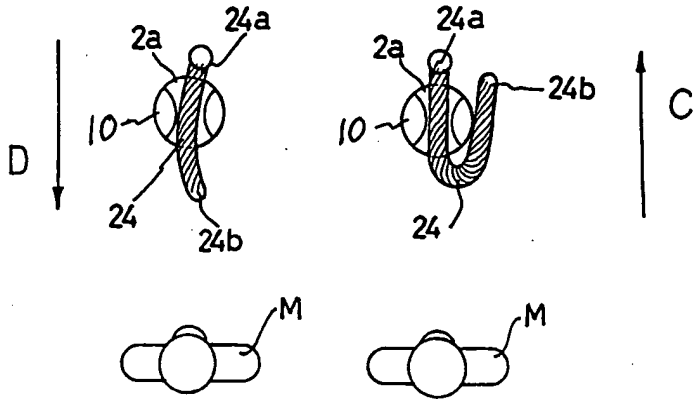

200
250
Interface
210
230
Input Device
CPU
Memory
220
Display
240

FIG. 2

FIG. 3A FIG. 3B



PRIOR ART

FIG. 3C

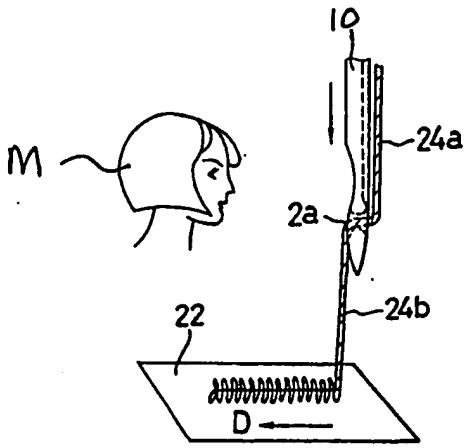
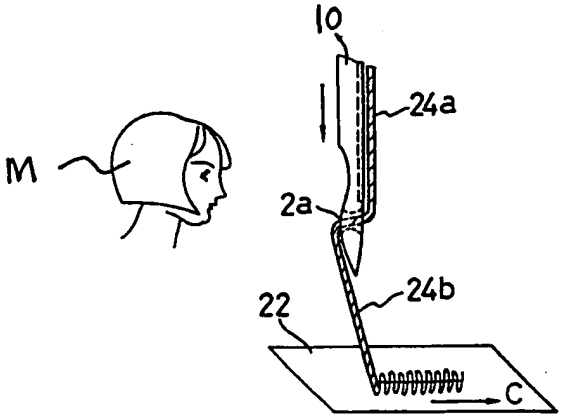
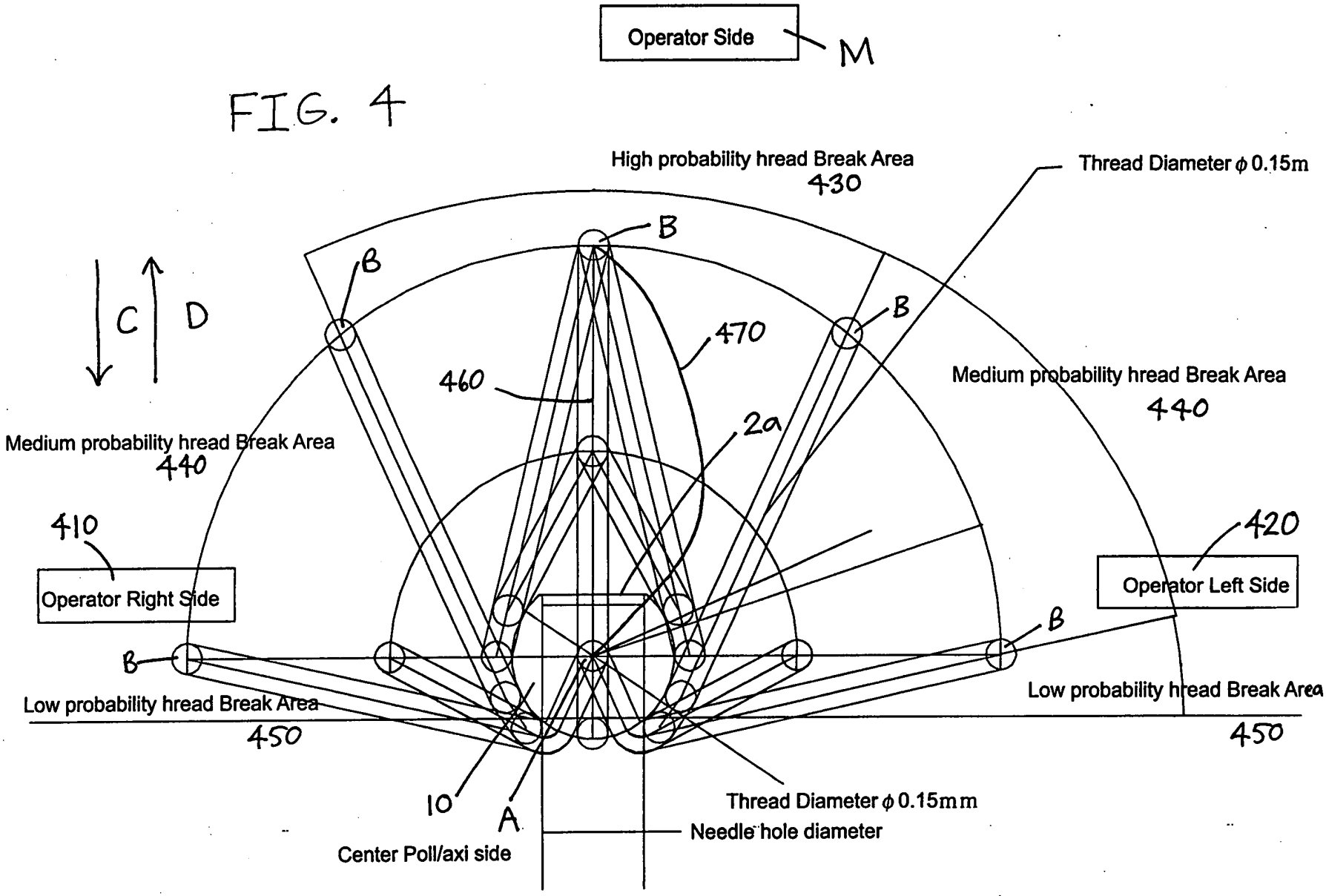


FIG. 3D



PRIOR ART

FIG. 4


Operator Side
M
High probability hread Break Area
430
Thread Diameter ϕ 0.15m
B
B
B
C
D
470
460
2a
Medium probability hread Break Area
440
Medium probability hread Break Area
440
410
Operator Right Side
420
Operator Left Side
B
B
Low probability hread Break Area
450
Low probability hread Break Area
450
10
A
Thread Diameter ϕ 0.15mm
Needle hole diameter
Center Poll/axi side

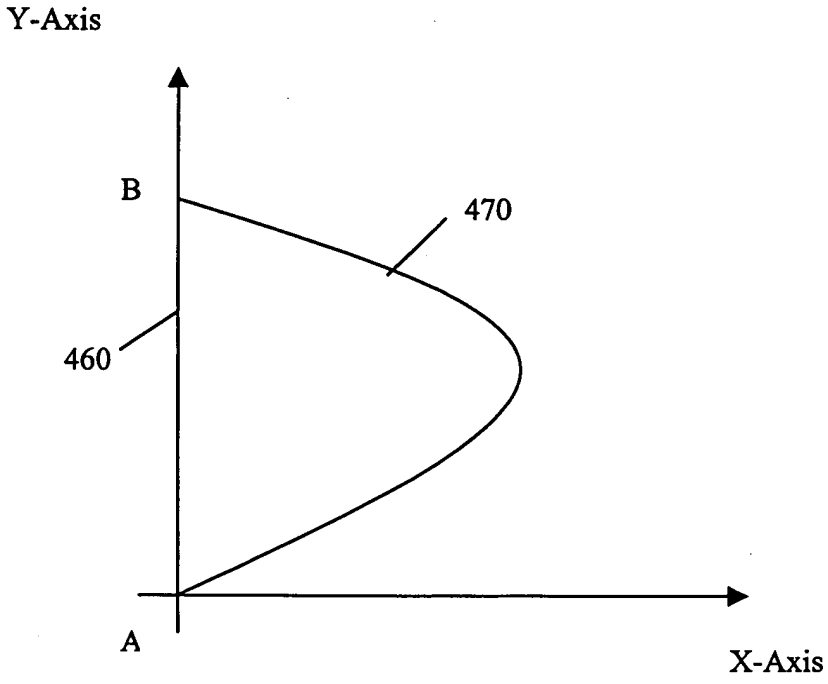


FIG. 5

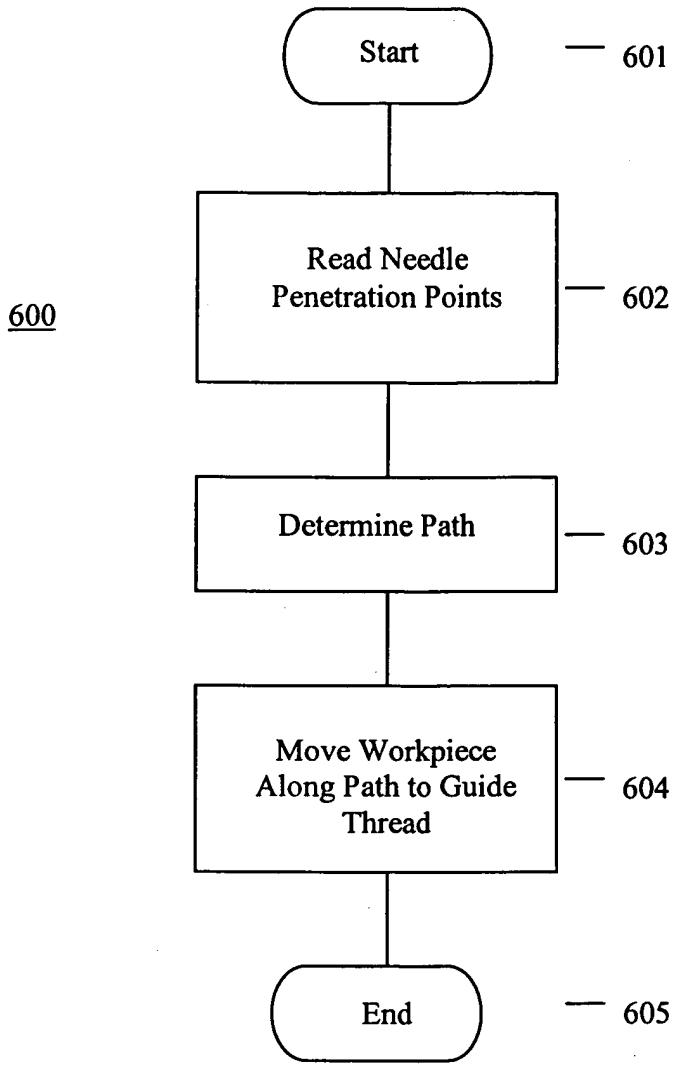

600
Start
601
Read Needle Penetration Points
602
Determine Path
603
Move Workpiece Along Path to Guide Thread
604
End
605

FIG. 6